

MOBILE SATELLITE SERVICE IN THE UNITED STATES

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ABSTRACT

Mobile Satellite Service (MSS) has been under development in the United States for more than two decades. The service will soon be provided on a commercial basis by a consortium of eight U.S. companies called the American Mobile Satellite Consortium (AMSC). AMSC will build a three-satellite MSS system that will offer superior performance, reliability and cost effectiveness for organizations requiring mobile communications across the U.S. The development and operation of MSS in North America is being coordinated with Telesat Canada and Mexico. AMSC expects NASA to provide launch services in exchange for capacity on the first AMSC satellite for MSAT-X activities and for government demonstrations.

INTRODUCTION

Mobile Satellite Service (MSS) will provide reliable mobile and thin-route communications throughout the United States. MSS is uniquely suited to organizations with geographically dispersed operations and with requirements for ubiquitous communications. MSS will be provided in this country by the American Mobile Satellite Consortium (AMSC, 1988).

The AMSC MSS system has substantial advantages over alternative systems for wide area mobile communications and position location. The system uses an SCPC architecture that is flexible and that can address broad markets, resulting in economies of scale. The system is well suited to fleet management applications, particularly where flexibility and reliability are critical. It is also well suited to the support of public safety, aviation safety, and resource exploration and development applications.

The Federal Communications Commission has determined that MSS will be provided in the United States by AMSC, which includes all eight qualified U.S. MSS applicants (see Table 1). Each of the members of AMSC has placed \$5 million in a joint escrow account. This \$40 million joint account may be used for initial capitalization of the consortium. AMSC filed a Joint Amendment to the applications of its eight members on February 1, 1988 that describes its MSS system. The AMSC MSS system is also described in a companion paper in this volume.

Table 1. American Mobile Satellite Consortium Participants

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Telesat Canada, the designated Canadian MSS operator, and AMSC plan to develop, produce and operate closely coordinated satellite and ground systems. Joint implementation of the space segment eliminates the need for separate in-orbit spare satellites, since the Telesat and AMSC systems can back up each other. Further savings will be achieved in the ground segment by producing similar Network Operations and TT&C centers to operate the Telesat and AMSC mobile satellite systems. These ground facilities will then provide mutual backup.

The mutual backup of both the space and ground segments between Telesat and AMSC assures high system reliability. Communications between a fleet controller and mobiles can be relayed directly through the satellite, circumventing terrestrial links entirely and ensuring continuity of communications during disasters.

In studies and experiments over the past two decades, NASA has demonstrated all technical concepts necessary for mobile communications by satellite (ATS 1971-1982). AMSC looks forward to close cooperation with NASA as it implements its system. NASA has offered to provide launch services to AMSC in return for use of some of the capacity of the first generation mobile satellite system (NASA, 1985). NASA would use this capacity to perform technology experiments and to enable government agencies to assess the usefulness of MSS to their operations. Government applications include public safety, aviation safety, communications for wide and remote area coverage (police and border control), monitoring of hazardous material transport, and others. Two years after launch, NASA will return this capacity to AMSC. NASA includes a reservation for the AMSC launch in its current ELV manifest.

AMSC SERVICES

AMSC will provide a comprehensive "generic" mobile satellite service, providing economical services to land, maritime and aeronautical users. Through the use of a common space segment to provide all three classes of service, economies of scale are achieved that have prevented implementation of land or aeronautical mobile satellite services in the past.

AMSC will provide four basic services through its mobile satellite system:

- Mobile Telephone (interconnected with the public switched telephone network)
- Mobile Radio (dispatch), including voice and data services
- Aeronautical Service
- Transportable Telephone Service

Taken together, the potential market for these mobile satellite services is quite large. Market studies indicate that there is sufficient potential demand for these four basic services, beyond that which terrestrial systems could reasonably or economically satisfy, to fill the capacity of the AMSC mobile satellite system several times over (AMSC, 1988).

AMSC anticipates supporting other, ancillary services as well. These potential services include point-to-multipoint data distribution, paging, remote data collection, position location and new mobile services using alphanumeric terminals.

Land Mobile

The primary class of mobile satellite service for which AMSC perceives an unfilled need is communications for land vehicles over long ranges or in lightly populated areas. Land mobile satellite service applications for which substantial demand has been established include (AMSC, 1988):

- Rural Mobile Telephone and Radio
- Rail Mobile Telephone
- Interstate Trucking
- Mobile Paging/Dispatch
- Commercial Forest Services
- Emergency Services
- Government Services, including:
 - Public Safety (law enforcement, fire fighting, disaster management, search & rescue, and rural health)
 - Forest Service
 - Customs and Immigration

Aviation

The aviation community, through the Federal Aviation Administration (FAA) and the Canadian Department of Transportation (DOT), is now assessing its long range needs for aeronautical services (FAA, 1985). Those requirements include operational and passenger communications. Approximately 10% of the United States major air carrier fleet now provides terrestrial based passenger telephone service.

Satellites offer the only economically viable technology to serve certain aviation market requirements. The most important of the aeronautical services to be supplied by AMSC are those related to the safety and regularity of flight, the AMSS(R) services. While these services are of paramount importance, they do not require the full capacity of the system and cannot economically support a satellite system on their own. By supporting land, maritime and aeronautical mobile satellite services, a mobile satellite operator can build a system providing the lowest cost service to all users.

Maritime Services

Although inland and coastal marine vessels now enjoy a variety of communications options, many marine communications requirements remain inadequately addressed. For example, commercial operators of vessels operating over long routes through inland and

coastal waterways face substantially the same fleet management requirements and problems faced by interstate trucking. Indeed, the same safety and competitive pressures are at work in the marine freight transportation industry which drive the need for wide area private networks.

Transportable Services

Other services which the AMSC system can ably provide are characterized by a need for wide area coverage and long range or remote operation without the requirement that they operate from moving vehicles. These may be termed "transportable" because they typically involve transporting a portable terminal to the site where it will be used.

Rural telephone service, for those who can obtain it, has traditionally been expensive despite the telephone companies' high degree of subsidization by revenue generated from urban residential and business users. The high price is due to low subscriber densities (less than five subscribers per square mile). In addition, the very long local loops which are required to provide this service can have a significant impact on cost.

Despite these high costs in the past, the cross-subsidization of rural local loops restricted technological innovation. Now, deregulation of the telecommunications industry and other regulatory developments are reducing or eliminating the revenue sources that provided past subsidies. MSS will supplement existing and developing terrestrial technologies in the provision of ubiquitous rural telephone service.

In addition to rural voice telephone service, the gathering of data for production control, monitoring, and planning purposes at oil and gas wells, on natural gas and other pipelines, and electric utility remote transmission and distribution facilities can often only be effectively supported through a satellite service. The AMSC system will be especially attractive for these data transmission requirements because it can economically support low capacity transportable terminals.

Other activities with similar requirements include aeronautical navigation aid monitoring, flood control, and water management at dams, remote weather and forest fire observation stations, seismic monitoring, and remote security systems.

ALTERNATIVE SYSTEMS

Terrestrial Systems

The predominant methods of land mobile communications currently include cellular radio telephone service, Specialized Mobile Radio (SMR), and private networks. While each of these services, within their current geographical areas, provide users with a reasonable level of service, there are limitations of each upon which MSS can improve.

The economic feasibility of all terrestrial based mobile systems is sensitive to subscriber density. At lower densities, MSS will be more economical than terrestrial services. MSS also offers improved service in areas difficult to serve because of rough terrain. Moreover, MSS offers private network users distinct advantages when large areas of coverage are required. For example, the AMSC MSS system is independent of any ground network, and is thus not susceptible to terrestrial disasters.

Satellite Systems

Two satellite systems have been proposed as early alternatives to MSS: the Omninert "Omnitracs" system (Omninet, 1987) and the Geostar Radiodetermination Satellite Service (RDSS) system (Geostar, 1985).

Only the AMSC mobile satellite system can provide voice services. AMSC will also provide data and positioning services much more effectively than any alternative.

Satellite-based systems, if properly designed, are not susceptible to disruptions in the terrestrial network caused by local disasters. This makes them particularly attractive for applications which require high reliability and which must count on immediate access in emergencies. Of the satellite systems now under development, only the AMSC system can circumvent the terrestrial network through the use of base stations at private control centers. Also, only AMSC will have backup capacity available on both the ground and in space. Thus, only the AMSC MSS system is satisfactory for applications in which full redundancy and independence of terrestrial links is critical.

Also, the AMSC system will cost substantially less for subscribers than the Omnitrac and Geostar systems. Omnitrac requires complex, expensive K_u band terminals and uses K_u band transponder capacity inefficiently. RDSS is inherently more expensive to provide than MSS because of the need for extra satellites for triangulation measurements, the need for separate transmit and receive antennas on mobiles and the inability to aggregate services through a common satellite (precluding economies of scale).

Table 2 compares mobile communications and position location alternatives.

Table 2. *Mobile Communications and Position Location Comparison*

<i>System</i>	<i>MSS</i>	<i>Cellular</i>	<i>SMR</i>	<i>Private</i>	<i>Omnitrac</i> ¹	<i>RDSS</i> ²
<i>Coverage</i>	North America	Local	Local	Local	U.S.	U.S.
<i>Voice</i>	Yes	Yes	Yes	Yes	No	No
<i>Base Stations</i>	Yes	No	No	Yes	No	No
<i>Redundant</i>	Yes	No	No	No	No	No
<i>Ground Segment</i>						
<i>Mobile Antennas</i>	1	1	1	1	1	2
<i>Position Location</i>	Yes ³	No	No	No	No ⁴	Yes

¹ Omninet has not been authorized to provide service.

² RDSS has been authorized to provide only position messaging and ancillary messaging. It is not authorized to provide communications services.

³ MSS can determine position through use of satellite ranging or integrated MSS/GPS transceivers.

⁴ Omnitrac uses Loran-C receivers for position location.

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